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TROUT LAKE, VILAS COUNTY, WISCONSIN

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center
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June 1975

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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NATIONAL EUTROPHICATION SURVEY

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REPORT
ON
TROUT LAKE
VILAS COUNTY
WISCONSIN
EPA REGION V
WORKING PAPER No. 71

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

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ON
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WITH THE COOPERATION OF THE
WISCONSIN DEPARTMENT OF NATURAL RESOURCES
AND THE
WISCONSIN NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS*

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

* The lake discussed in this report was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. Tributaries were not sampled, and this report relates only to the data obtained from lake sampling.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conducting the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

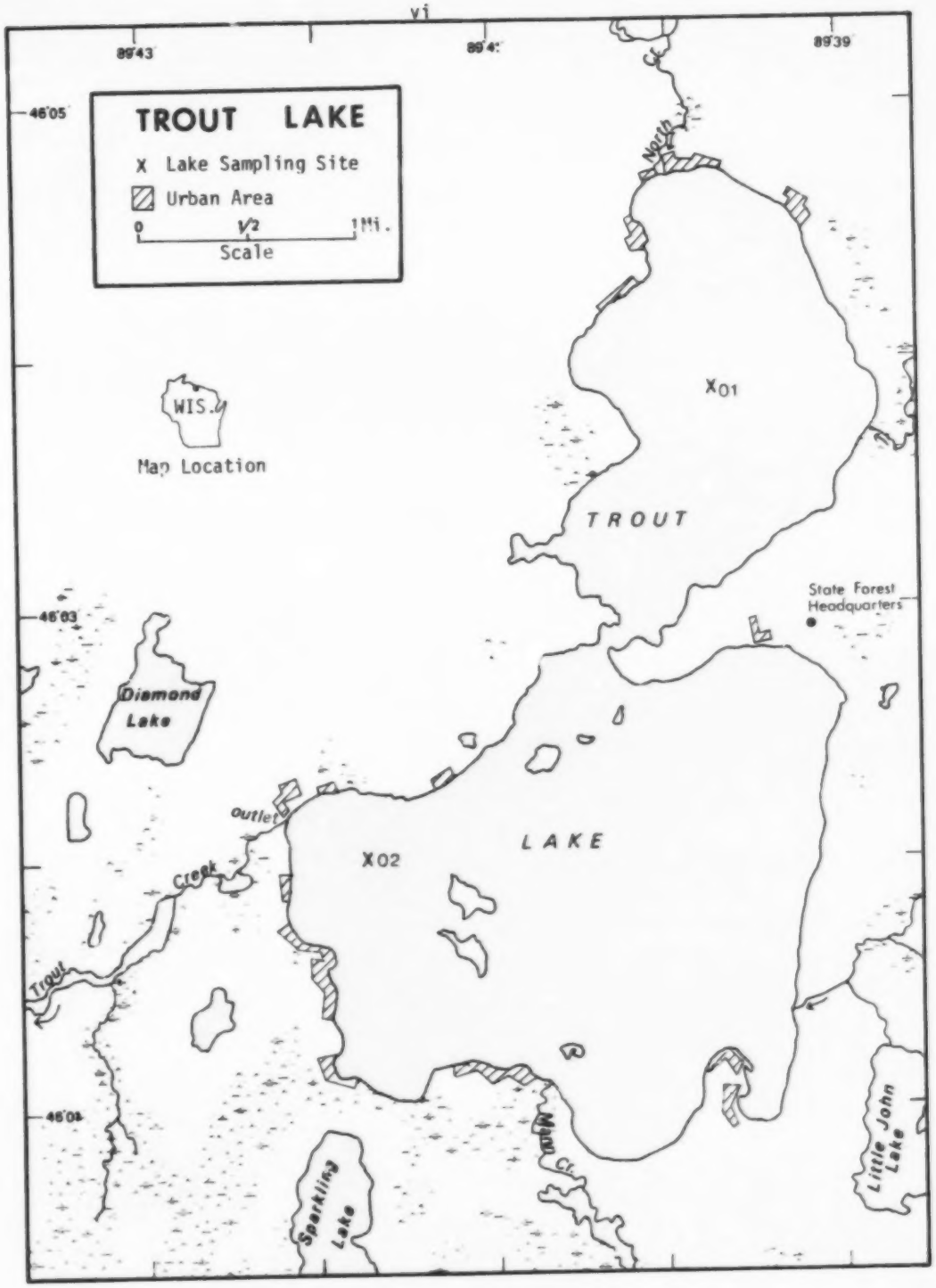
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano
Sinnissippi	Dodge

LAKE NAME	COUNTY
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


89°43'
89°41'
89°39'
46°05'
TROUT LAKE
X Lake Sampling Site
Urban Area
0 ½ 1 Mi.
Scale
WIS.
Map Location
X01
TROUT
LAKE
X02
State Forest Headquarters
46°03'
Diamond Lake
Outlet
Creek
Trout
46°01'
Sparkling Lake
Little John Lake

TROUT LAKE

STORET NO. 5572

I. INTRODUCTION

Trout Lake was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. Tributaries were not sampled, and no wastewater treatment plants impact the lake. Therefore, this report only relates to lake sampling data.

II. CONCLUSIONS

A. Trophic Condition:

Survey data and a report by others (Lueschow, et al., 1970) indicate Trout Lake is mesotrophic. Of the 46 Wisconsin lakes sampled, one had less and one the same mean total phosphorus, one had less and two the same mean dissolved phosphorus, two had less mean inorganic nitrogen, two had less mean chlorophyll a, and two had greater Secchi disc transparency. Dissolved oxygen was depressed at depth at both sampling stations in August, 1972.

B. Rate-Limiting Nutrient:

The algal assay results indicate Trout Lake was co-limited by phosphorus and nitrogen at the time the sample was taken (11/04/72). The lake data indicate nitrogen limitation in June but phosphorus limitation in August.

III. LAKE CHARACTERISTICS

A. Lake Morphometry*:

1. Surface area: 3,870 acres.
2. Mean depth: 37.8 feet.
3. Maximum depth: 115 feet.
4. Volume: 146,152 acre-feet.

C. Precipitation**:

1. Year of sampling: 43.3 inches.
2. Mean annual: 31.3 inches.

---

* Ball, 1973.
** See Working Paper No. 1, "Survey Methods, 1972".

IV. LAKE WATER QUALITY SUMMARY

Trout Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page vi). During each visit, a single depth-integrated (15 feet to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 74 feet at station 1 and 40 feet at station 2.

The results obtained are presented in full in Appendix A, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix A.

A. Physical and chemical characteristics:

FALL VALUES

(11/04/72)

Parameter	Minimum	Mean	Median	Maximum
Temperature (Cent.)	5.1	5.5	5.7	5.9
Dissolved oxygen (mg/l)	10.0	10.7	10.6	11.0
Conductivity (μmhos)	100	105	102	122
pH (units)	7.1	7.2	7.2	7.2
Alkalinity (mg/l)	28	33	33	39
Total P (mg/l)	0.008	0.009	0.009	0.011
Dissolved P (mg/l)	0.004	0.006	0.005	0.009
NO_2 + NO_3 (mg/l)	0.030	0.034	0.030	0.040
Ammonia (mg/l)	0.030	0.044	0.040	0.060
ALL VALUES				
Secchi disc (inches)	120	162	162	216

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/25/72	1. Dinobryon	1,215
	2. Microcystis	166
	3. Fragilaria	159
	4. Anabaena	94
	5. Oocystis	72
	Other genera	246
	Total	1,952
08/23/72	1. Dinobryon	2,550
	2. Microcystis	669
	3. Anabaena	416
	4. Chroococcus	253
	5. Schroederia	181
	Other genera	217
	Total	4,286
11/04/72	1. Stichococcus	1,508
	2. Flagellates	1,357
	3. Microcystis	754
	4. Dinobryon	578
	5. Cyclotella	578
	Other genera	2,587
	Total	7,362

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/25/72	01	2.5
	02	2.9
08/23/72	01	1.5
	02	1.9
11/04/72	01	3.6
	02	3.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.008	0.054	0.7
0.005 P	0.013	0.054	1.0
0.010 P	0.018	0.054	0.9
0.020 P	0.028	0.054	1.2
0.050 P	0.058	0.054	0.9
0.050 P + 1.0 N	0.058	1.054	26.8
1.0 N	0.008	1.054	0.7

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Trout Lake was moderate at the time of sample collection (11/04/72). Also, the results suggest that the lake was co-limited by nitrogen and phosphorus. The combined nitrogen and phosphorus spike resulted in the maximum yield, but no

significant growth response resulted when only nitrogen or phosphorus were added. The lake data also indicate co-limitation; the mean N/P ratio in November was 13/1.

The lake data indicate nitrogen limitation in June (N/P = 3/1) but phosphorus limitation in August (N/P = 17/1).

V. LITERATURE REVIEWED

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APPENDIX A

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/09/30

SS7201
46 03 56.0 089 39 48.0
TROUT LAKE
55 WISCONSIN

11EPALES
3

2111202
0080 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/25	15 20	0000	16.1	10.0	216	90	7.90	42	0.030	0.010K	0.005	0.007
	15 20	0015	15.8	10.3				40	0.030	0.020	0.006	0.007
	15 20	0072	5.0	8.9		90	8.00	40	0.070	0.030	0.012	0.006
72/08/23	13 00	0000			192	90	7.95	41	0.030	0.060	0.007	0.005
	13 00	0004	20.7	8.7		89	7.90	41	0.030	0.060	0.007	0.005
	13 00	0015	20.4	8.7		90	8.05	42	0.040	0.050	0.007	0.003
	13 00	0020	20.2	9.0		89	7.80	39	0.030	0.050	0.008	0.005
	13 00	0028	17.2	9.2		89	7.80	39	0.040	0.080	0.007	0.003
	13 00	0036	9.7	9.3		90	7.10	39	0.040	0.060	0.006	0.004
	13 00	0046	6.7	8.1		90	6.90	37	0.030	0.050	0.009	0.005
	13 00	0056	6.0	5.9		89	6.70	39	0.030	0.060	0.010	0.004
	13 00	0066	5.4	5.9		90	6.60	37	0.080	0.050	0.010	0.006
	13 00	0074	5.4			93	6.60	34	0.140	0.080	0.042	0.006
72/11/04	13 20	0000	5.8	10.6	120	102	7.10	33	0.030	0.040	0.008	0.004
	13 20	0004						34	0.040	0.040	0.011	0.006
	13 20	0015	5.7	10.6		100	7.20	35	0.040	0.050	0.009	0.005
	13 20	0022	5.8	10.6		100	7.20	35	0.030	0.040	0.009	0.005
	13 20	0030	5.8	10.6		100	7.20	36	0.030	0.040	0.008	0.005
	13 20	0040	5.8	10.6		118	7.20	37	0.040	0.050	0.009	0.009
	13 20	0045	5.9	10.0		100	7.20	39	0.040	0.060	0.009	0.006

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/25	15 20	0000	2.5J
72/08/23	13 00	0000	1.5J
72/11/04	13 20	0000	3.6J

K VALUE KNOWN TO BE LESS THAN INDICATED

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/09/30

557202
46 02 00.0 089 41 48.0
TROUT LAKE
55 WISCONSIN

11EPALES 2111202
3 0035 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/25	16 00	0000	17.0	10.6	180	90	8.10	42	0.040	0.040	0.006	0.004
	16 00	0015	16.1	10.6		90	8.00	41	0.030	0.030	0.009	0.009
	16 00	0030	13.3	10.5		90	7.70	40	0.040	0.030	0.110	0.070
72/08/23	12 25	0000			144	93	7.50	36	0.040	0.060	0.011	0.005
	12 25	0004	20.3	8.6		89	7.80	36	0.040	0.060	0.011	0.005
	12 25	0015	20.3	8.6		90	7.90	36	0.040	0.050	0.008	0.005
	12 25	0022	20.2	7.1		93	7.10	38	0.040	0.050	0.009	0.007
	12 25	0030	18.1	7.2		94	7.15	38	0.030	0.050	0.010	0.005
	12 25	0038	12.0	4.0		95	6.55	38	0.040	0.050	0.012	0.009
72/11/04	14 20	0000			120	108	7.20	28	0.030	0.040	0.008	0.005
	14 20	0004	5.1	11.0		122	7.20	29	0.030	0.040	0.008	0.005
	14 20	0015	5.1	11.0	.	105	7.20	31	0.030	0.040	0.009	0.009
	14 20	0022	5.1	11.0		105	7.20	31	0.030	0.040	0.009	0.005
	14 20	0030	5.1	11.0		102	7.20	33	0.030	0.030	0.009	0.004
	14 20	0040	5.1	10.8		100	7.20	33	0.040	0.060	0.008	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/25	16 00	0000	2.9J
72/08/23	12 25	0000	1.9J
72/11/04	14 20	0000	3.7J

J VALUE KNOWN TO BE IN ERROR